$\vec{u} = \langle 4, -2, 5 \rangle \qquad \vec{v} = \langle 5, -1, 1 \rangle$

(5a) $\vec{u} \cdot \vec{v}$

$= (4)(5) + (-2)(-1) + (5)(-1)$

$= 17$

(5b) $\vec{u} \times \vec{v}$

$$\begin{bmatrix} \hat{i} & 4 & 5 \\ \hat{j} & -2 & -1 \\ \hat{k} & 5 & -1 \end{bmatrix}$$

$= [(-2)(-1) - (5)(-1)]\hat{i} - [(4)(-1) - (5)(5)]\hat{j} + [(4)(-1) - (5)(-2)]\hat{k}$

$= 7\hat{i} + 29\hat{j} + 6\hat{k}$

$\langle 7, 29, 6 \rangle$

(5c) θ between $\vec{u}$ and $\vec{v}$

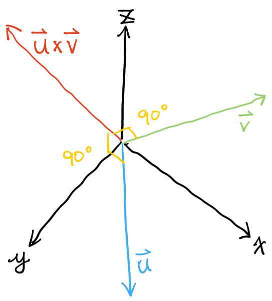
$\vec{u} \cdot \vec{v} = \|\vec{u}\| \|\vec{v}\| \cdot \cos\theta$

$\theta = \cos^{-1}\left(\frac{\vec{u} \cdot \vec{v}}{\|\vec{u}\|\|\vec{v}\|}\right)$

$= \cos^{-1}\left(\frac{17}{\sqrt{(4)^2 + (-2)^2 + (5)^2}\,\sqrt{(5)^2 + (-1)^2 + (-1)^2}}\right)$

≈ 1.0613 rad

(5d) φ between $\vec{u}$ and $\vec{u} \times \vec{v}$



the cross product of two vectors results in a vector that is orthogonal to the two orignal vectors.

Prove : $\vec{u} \times \vec{v} = \langle 7, 29, 6 \rangle$

$\vec{u} \cdot (\vec{u} \times \vec{v}) = \|\vec{u}\| \|\vec{u} \times \vec{v}\| \cos\varphi$

$\varphi = \cos^{-1}\left(\frac{\vec{u} \cdot (\vec{u} \times \vec{v})}{\|\vec{u}\|\|\vec{u} \times \vec{v}\|}\right)$

$\varphi = \frac{\pi}{2}$ rad